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PATENT

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_____   _____

Date   Joanne Bourguignon

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: William S. Worley, Jr.
Application No.: 10/789,783
Filed: February 27, 2004
Title: OPERATING SYSTEM CAPABLE OF SUPPORTING A
                 CONCURRENT CUSTOMIZED EXECUTION
ENVIRONMENT

                                  Examiner: BULLOCK, Lewis A.
                                  Art Unit: 2195
                                  Docket No.: 35064.006
                                  Date: November 5, 2008

MAIL STOP AMENDMENT
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT

Sir:

        In response to the telephone interview of October 23, 2008, with the Examiner, please amend the application as follows:

OK TO ENTER - J.W. 11/7/08

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AMENDMENTS TO THE SPECIFICATION

Please amend paragraph [0034], beginning on page 11 as follows:

[0034]   Embodiments of the present invention may be provided as a computer program product, which may include a machine-readable medium having stored thereon instructions that ~~may be~~ are used to program a computer (or other electronic devices) to perform a process. The machine-readable medium may include, but is not limited to, magnetic disks, floppy diskettes, optical disks, compact disc read-only memories (CD-ROMs, CD-Rs, CD-RWs), digital versatile disks (DVD-ROM, DVD+RW), and magneto-optical disks, ROMs, random access memories (RAMs), erasable programmable read-only memories (EPROMs), electrically erasable programmable read-only memories (EEPROMs), magnetic or optical cards, and flash memory~~, or other type of media/machine readable medium suitable for storing electronic instructions~~. Moreover, embodiments of the present invention may also be downloaded as a computer program product, wherein the program may be transferred from a remote computer to a requesting computer by way of data signals embodied in a carrier wave or other propagation medium via a communication link (e.g., a modem or network connection).

Please amend paragraph [0038], beginning on page 12 as follows:

[0038]   The phrase "Customized Execution Environment" or "CE^2" ~~generally~~ refers to a customized operating environment itself, in which there is provided a set of system services implemented in software having direct access and full control over a portion of system resources. CE^{2}s are quite distinct from an operating system or specialized operating system and ~~depending upon the particular embodiment may include~~

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~~one or more of the following features~~ are characterized by:

1.   A CE^2 ~~may comprise~~ comprises both statically linked system code and data modules and application code and data modules;

2.   A CE^2 ~~may lack~~ lacks the capability to load or to load and execute any other application;

3.   The functional capabilities of a CE2 ~~may be strictly~~ are limited to only those services required by a particular application or small set of predetermined applications;

4.   A CE^2 ~~typically~~ falls far short of the capabilities expected of an operating system; specifically, ~~in one embodiment,~~ applications are limited to a single thread of execution ~~in~~ on each ~~processor~~ of one or more processors controlled by the CE^2;

5.   The services interfaces of a CE2 ~~may be~~ are simple and specialized for each of one or a small set of particular applications, rather than being comprised by a more complex and general Application Programming Interface (API) for a broad class of applications;

6.   ~~Management strategies for system resources sometimes differ entirely from those strategies adopted by traditional general-purpose operating systems;~~

6~~7~~.   A CE^2 ~~may utilize~~ utilizes hardware capabilities not supported by a general-purpose or symbiotic general-purpose operating system;

7~~8~~.   A CE^2 ~~may make~~ makes substantial use of hardware capabilities not well utilized by a general-purpose or symbiotic general-purpose operating system;

8~~9~~.   The services provided to the application within a CE^2 ~~may be~~ are designed to enable an application far more easily to recover and continue from a

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system error.

<u>and may be additionally characterized by:</u>

910.   Management strategies for system resources ~~sometimes~~ differ ~~entirely~~
        from those strategies adopted by traditional general-purpose operating
        systems;

According to one embodiment of the present invention, a general-purpose operating system at least temporarily relinquishes control of all or a portion of system resources associated with a computer system to one or more CE^2s. According to another embodiment, a CE^2 may be booted on hardware directly. For example, a general-purpose operating system may launch a CE^2 without ever taking control over the portion of system resources to be controlled by the CE^2. In still another embodiment, both the general-purpose operating system and one or more CE^2s may be booted into distinct hardware partitions such as those provided in the Hewlett Packard Superdome platform. CE^2s are typically specialized for a particular hardware platform. According to one embodiment, a CE^2 is non-portable and there are no general-purpose operating system abstractions interposed between the customized execution environment and the system resources allocated to the customized execution environment. Typically, system services provided by a CE^2 will implement a simplified computational structure and/or an I/O structure that are tuned for a particular application. For example, a CE^2 may take advantage of certain processor or other system resource features that are not exploited by the general-purpose operating system. According to one embodiment, a tuned CE^2 is provided to support a web edge engine, such as a web server, secure web server, proxy server, secure proxy server or other application or communication servers, to allow the web edge engine to drive the utilization of network connections as close as possible to 100%.

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AMENDMENTS TO THE CLAIMS

1.   (previously presented)A method comprising:

providing a computer-readable medium encoded with instructions that implement one or more customized execution environments, each customized execution environment providing an execution environment for a single application and exclusively managing a subset of hardware resources of a computer system, with no operating system abstractions or interfaces interposed between the customized execution environment and the subset of hardware resources;

determining which hardware resources of the computer system are to remain under control of a resident operating system executing within the computer system and which of the hardware resources of the computer system constitute each subset of hardware resources of the computer system managed exclusively by one of the one or more customized execution environments; and

partitioning the hardware resources among the resident operating system and the one or more customized execution environments by associating one or more partitions of the hardware resources with the one or more customized execution environments.

2.   (previously presented) The method of claim 1, wherein said partitioning the hardware resources comprises the resident operating system configuring the one or more partitions using hardware-based isolation features provided by one or more processors of the computer system.

3.   (original) The method of claim 2, further comprising the resident operating system entering a dormant state.

4.   (previously presented) The method of claim 1, wherein said partitioning the hardware resources comprises the operating system configuring the one or more partitions using a secure-platform interface.

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5.   (previously presented) The method of claim 4, further comprising the resident operating system retaining full control of one or more of the partitions and remaining active after said partitioning the hardware resources.

6.   (previously presented) The method of claim 1, wherein said partitioning the hardware resources comprises a system administrator configuring the one or more partitions using hardware partitioning capability by the computer system.

7.   (previously presented) The method of claim 6, further comprising separately booting the resident operating system and the one or more customized execution environments within their respective configured partitions.

8.   (previously presented) The method of claim 1, further comprising a customized execution environment of the one or more customized execution environments making use of capabilities of the computer system not supported by the resident operating system.

9.   (previously presented) The method of claim 1, wherein a customized execution environment of the one or more customized execution environments comprises both statically linked system code and data modules and application code and data modules.

10.   (previously presented) The method of claim 1, wherein functional capabilities of a customized execution environment of the one or more customized execution environments is strictly limited to only those services required by a small set of predetermined applications.

11.   (previously presented) The method of claim 1, where in an application within a customized execution environment of the one or more customized execution environments is limited to a single thread of execution in a processor controlled by the CE^2.

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12.   (previously presented) The method of claim 1, wherein a customized execution environment of the one or more customized execution environments utilizes hardware capabilities not supported by the resident operating system.

13.   (previously presented) The method of claim 1, wherein services provided to an application within a customized execution environment of the one or more customized execution environments enable the application to recover and continue from a system error.

14.   (previously presented) The method of claim 1, wherein a customized execution environment of the one or more customized execution environments is non-portable.

15.   (previously presented) The method of claim 1, wherein services provided to an application within a customized execution environment of the one or more customized execution environments utilize no general-purpose operating system abstractions.

16.   (previously presented) The method of claim 1, wherein services within a customized execution environment employ entirely different resource management strategies than those used by a general-purpose operating system.

17.   (previously presented) A method comprising
       providing a computer-readable medium encoded with instructions that implement a customized execution environment, the customized execution environment providing an execution environment for a single application, and exclusively managing a subset of hardware resources of a computer system, with no operating system abstractions or interfaces interposed between the customized execution environment and the subset of hardware resources;

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partitioning, by an operating system executing within the computer system, the ~~system~~ hardware resources of the computer system, including one or more processors and one or more ranges of physical memory, by

determining which of the hardware resources are to remain under control of the operating system and which of the hardware resources are to be placed within the subset of hardware resources exclusively managed by the customized execution environment

associating a first partition of the hardware resources with the customized execution environment; and

the operating system surrendering full control of the first partition of the ~~system~~ hardware resources to the customized execution environment.

18.   (previously presented) The method of claim 17, wherein the information regarding a customized execution environment includes a directive to partition hardware resources and an associated partition descriptor, the partition descriptor identifying hardware resources needed by the customized execution environment and indicating how partitions are to be configured.

19.   (previously presented) The method of claim 17, wherein said associating a first partition of the hardware resources with the customized execution environment comprises disassociating those of the hardware resources in the first partition from the operating system and reconfiguring interrupts.

20.   (previously presented) The method of claim 17, further comprising:

the operating system retaining full control of a second partition of the hardware resources; and

isolating the second partition of the hardware resources to protect the hardware resources associated with the operating system from the customized execution environment by employing hardware isolation.

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21.   (previously presented) The method of claim 20, further comprising isolating the first partition of the hardware resources to protect the hardware resources associated with the customized execution environment from the operating system by employing hardware isolation.

22.   (previously presented) The method of claim 20, wherein the hardware isolation comprises establishing one or more disjoint sets of protection keys for one or more operations on one or more ranges of virtually addressed memory in the first or second partitions of the hardware resources.

23.   (previously presented) The method of claim 20, wherein the hardware isolation comprises establishing one or more disjoint sets of region identifiers for one or more operations on one or more ranges of virtually addressed memory in the first or second partitions of the hardware resources.

24.   (previously presented) The method of claim 20, wherein the hardware isolation comprises associating one or more ranges of memory in the second partition of the hardware resources with a processor in the second partition, and associating one or more ranges of memory in the first partition of the hardware resources with a processor in the first partition.

25.   (previously presented) The method of claim 24, wherein said associating one or more ranges of memory in the second partition of the hardware resources with a processor in the second partition, and said associating one or more ranges of memory in the first partition of the hardware resources with a processor in the first partition, comprises employing a region-identifier-based memory partitioning mechanism.

26.   (previously presented) The method of claim 17, further comprising:

        receiving an indication that the customized execution environments is terminating; and

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the operating system assuming control of the first partition of the hardware resources.

27.   (previously presented) A system comprising:

a computer-readable medium encoded with instructions that implement a resident operating system and one or more customized execution environments, each customized execution environment providing an execution environment for a single application, and exclusively managing a subset of hardware resources of a computer system, with no operating system abstractions or interfaces interposed between the customized execution environment and the subset of hardware resources;

one or more processors, coupled to the one or more storage devices, that execute the resident operating system and the customized control environment, where:

a determination is made with respect to which portion of hardware resources of the system, including the one or more processors and memory of the system, are to remain under control of the resident operating system and which portion of the hardware resources are to be placed under control of the one or more customized execution environments; and   ·

the hardware resources are partitioned among the resident operating system and the one or more customized execution environments by associating one or more portions of the hardware resources with the one or more customized execution environments.

28.   (previously presented) A server comprising:

a computer-readable medium encoded with instructions that implement a resident operating system and one or more concurrent customized execution environments, each customized execution environment providing an execution environment for a single application, and exclusively managing a subset of hardware resources of a computer system, with no operating system abstractions or interfaces interposed between the customized execution environment and the subset of hardware resources, the resident operating system capable of establishing a first partition of

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hardware resources for use and control by the operating system and a second partition of hardware resources for use and control by the concurrent customized execution environments;

one or more storage devices having stored thereon software images of an operating system and customized control environment and services associated with a concurrent custom execution environment, the operating system capable of establishing a first partition of resources for use and control by the operating system and a second partition of resources for use and control by the C^2E^2;

one or more processors, coupled to the computer-readable medium, to that execute the resident operating system, where:

a first portion of one or more storage devices, a first portion of the one or more processors, a first portion of memory, and a first portion of one or more input/output (I/O) devices are associated with the first partition by the operating system;

a second portion of one or more storage devices, a second portion of the one or more processors, a second portion of the memory, and a second portion of the one or more input/output (I/O) devices are associated with the second partition by the resident operating system;

the first partition is isolated to protect the hardware resources associated with the resident operating system from the concurrent custom execution environment by employing hardware-based security measures; and

full control of the second partition is surrendered to the concurrent custom execution environment by the resident operating system initializing and invoking the customized control environment and services in the second portion of memory.

29.   (previously presented) The server of claim 28, wherein the second partition is isolated to protect the hardware resources associated with the concurrent custom execution environment from the resident operating system by employing hardware-based security measures.

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30.   (original) The server of claim 28, wherein the customized control environment and services are non-portable.

31.   (original) The server of claim 28, wherein the first partition includes at least one processor.

32.   (original) The server of claim 28, wherein the second partition includes at least one processor.

33.   (original) The server of claim 28, wherein the one or more storage devices have stored thereon a software image of a customized application for which a computational structure of the customized control environment and services has been tuned.

34.   (original) The server of claim 33, wherein the customized application comprises a web edge engine.

35.   (original) The server of claim 34, wherein the web edge engine comprises a web server.

36.   (original) The server of claim 34, wherein the web edge engine comprises an application server.

37.   (original) The server of claim 34, wherein the web edge engine comprises a communication server.

38.   (original) The server of claim 28, wherein a communication channel is maintained between the first partition and the second partition, and wherein a dynamic content generator executes within the first partition and provides dynamic content to the web server via the communication channel.

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39.   (original) The server of claim 28, wherein the hardware-based security measures comprise use of one or more of region identifiers, protection identifiers, and memory page access rights values.

40.   (currently amended) ~~An~~ A computer-readable medium having an operating system stored thereon, the operating system comprising:

        a means for partitioning hardware resources into a least a first partition to remain under the control of the operating system, which executes within a computer system, and a second partition that is to be placed under the full control of a concurrent custom execution environment, the concurrent customized execution environment providing an execution environment for a single application, and exclusively managing a subset of hardware resources of the computer system, with no operating system abstractions or interfaces interposed between the customized execution environment and the subset of hardware resources;

        an interface means to hardware-based isolation features for protecting the ~~system~~ hardware resources of the first partition against access by the concurrent custom execution environment;

        a means for transferring full control of the hardware resources of the second partition to the concurrent custom execution environment, including initializing and invoking customized control and services associated with the concurrent custom execution environment; and

        a means for providing communication between the first partition and the second partition.

41.   (previously presented) The operating system of claim 40, further comprising a means for reincorporating partitioned hardware resources.

42.   (previously presented) The operating system of claim 40, further comprising:

        separate means for operator control of the operating system and the concurrent custom execution environment; and

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separate interface means for monitoring the operating system and the concurrent custom execution environment.

43.   (currently amended) ~~An~~ <u>A computer-readable medium having an</u> operating system <u>stored thereon, the operating system</u> comprising:

a means for communicating with one or more concurrent custom execution environments operating within and controlling respective hardware-enforced partitions of hardware resources separate from a hardware-enforced partition of hardware resources in which the operating system resides, the concurrent customized execution environment providing an execution environment for a single application, and exclusively managing a subset of hardware resources of a computer system, with no operating system abstractions or interfaces interposed between the customized execution environment and the subset of hardware resources; and

a means for causing a concurrent custom execution environment of the one or more concurrent custom execution environment to begin processing or to terminate.
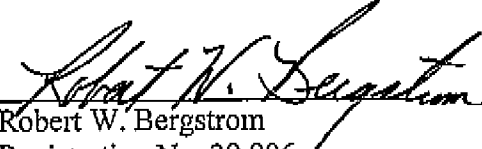
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REMARKS

In a telephone discussion with Examiner Wang, on Nov. 4th, 2008, Applicant's representative agreed to the above amendments to the claims and specification of the current application. Applicant's representative wishes to thank Examiner Wang, on his behalf and on behalf of Applicant, Bill Worley, for her attention to this application and assisting the Applicant in furthering prosecution of the current application. Should Applicant's representative have missed any agreed-to amendments, Applicant's representative will happily make additional amendments via telephone, email, or another written response.

In Applicant's representative's opinion, all of the claims remaining in the current application are clearly allowable. Favorable consideration and a Notice of Allowance are earnestly solicited.

Respectfully submitted,
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